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AN IMPROVED PLACE-PACKING STATION FOR

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CITRUS FRUIT

AMS-447

UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Marketing Service
Transportation and Facilities Research Division
in cooperation with the
Citrus Experiment Station of the
FLORIDA AGRICULTURAL EXPERIMENT STATION

PREFACE

This report is part of a cooperative research program by the Florida Agricultural Experiment Station and the Agricultural Marketing Service of the United States Department of Agriculture. The research is directed toward improved methods, equipment, and facilities for the handling and preparation for market of citrus fruits and vegetables at Florida shipping points. The study is part of a broad program of research aimed at improving market efficiency and expanding the market for farm products.

The preliminary work covered in this report was done in the citrus packinghouse provided for teaching purposes on the University of Florida campus. Commercial packinghouse facilities were made available for further steps in the development of the equipment.

The work was performed under the general supervision of Joseph F. Herrick, Jr., market research analyst, Handling and Facilities Research Branch, Transportation and Facilities Research Division, Agricultural Marketing Service. The Fruit Crops Department, University of Florida, cooperated generously in making available its facilities and in providing assistance for some of the packing trials. Special acknowledgment for assistance is due Dr. M. J. Soule, Jr., under whose supervision the University's packinghouse for citrus fruit is operated.

Dr. William Grierson, associate chemist, formerly of the Florida Citrus Experiment Station, Lake Alfred, Fla., gave valuable advice and suggestions. The Agricultural Engineering Department of the University of Florida consulted and advised through its research staff and other personnel.

The Roper Growers Cooperative, Winter Garden, Fla., made available facilities and workers for a packing trial and cooperated generously in developing information regarding construction and operation of roll-board packing facilities for commercial packinghouse conditions in their own packinghouse. Chase and Company, through their packinghouse at Windermere, Fla., also cooperated in developing information regarding adaptation of the equipment for commercial packinghouse use.

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Washington, D. C. July 1961

SUMMARY

Laboratory tests showed that about 20 percent of the packer's time could be saved if a roll-board type of packing station was used instead of bins in the place-packing of citrus fruit.

A major portion of the Florida citrus fruit marketed as fresh fruit is manually place-packed into shipping containers. This packing involves placing each fruit in the container in a specified pattern and requires many motions of the packer. In fact, one of the largest single expenditures for labor in plants packing citrus fruit is packer's wages.

Improvements which would reduce the time and effort required in place-packing were sought through a research program. The roll-board was the method selected for the experiment, and a model roll-board packing station was designed and constructed. The essential difference between this method and the conventional bin method was in the way fruit was placed before the packer and the improved motion pattern which the roll-board made possible.

Two commercial packinghouses installed roll-board packing facilities after the initial experimental work. Design and construction in these installations were based upon information obtained through the research. Although both of these packinghouses had central sizers by the time the roll-board packing stations were installed, the roll-board can be adapted to conventional belt-and-roll sizing equipment.

With two seasons of experience, both of the original roll-board installations have shown satisfactory results. The majority of the packers, who have had experience with the roll-board method of packing, agree that it is less fatiguing and permits greater output per packer.

AN IMPROVED PLACE-PACKING STATION FOR CITRUS FRUIT

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and
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BACKGROUND

Place-packing is the operation of manually placing fruit in a shipping container in a specified pattern. The citrus industry requires the use of definite patterns for packing specific types of containers with various sizes of fruit. These patterns include the number of layers of fruit to be packed in the container as well as the arrangement of the fruit in each layer. This place-packing operation has been a part of the normal packinghouse procedure since the beginning of the fresh citrus fruit industry in Florida.

Over the years changes which influence labor requirements have taken place in the packing operation as a result of adopting new types of containers. A packer can put out in a day about twice as many wirebound crates of nonwrapped fruit as standard crates of wrapped fruit. 1/ The nailed wooden box (standard crate), which predominated in the earlier years and for which it was customary to wrap each piece of fruit, has now been eliminated for commercial shipments. Use of the wirebound crate of the same capacity, in which the fruit is not normally wrapped, has increased so that a little more than two-thirds of the fresh citrus fruit shipped from Florida in the 1957-58 season was packed in this container. This proportion was less, however, than that shipped in the wirebound crate during the 1949-50 season, mainly because of increased use of mesh bags and fiberboard cartons. The proportion of volume shipped in mesh bags increased from 6 to 11 percent between the 1944-45 and 1949-50 seasons while the total fresh citrus fruit marketed declined about 9 percent. From that time through the 1958-59 season, the proportion of fruit shipped in bags ranged from 9 to 12 percent, including both the mesh bag and the bag made of plastic film, which has come into use more recently. The proportion of volume shipped in fiberboard cartons increased from about 1 percent to 27 percent between the 1949-50 and 1958-59 seasons. 2/

Despite the various changes in containers, wages paid to packing labor represent one of the largest single labor expenditures in citrus packinghouses. 3/ About three-fourths of the fresh citrus fruit shipped from Florida was place-packed in the 1956-57 season and approximately the same proportion was maintained through the 1958-59 season.

1/ Winston, J. R. Harvesting and Handling Citrus Fruits in the Gulf States. U. S. Dept. Agr. Farmers' Bul. 1763, 67 pp., illus. Rev. July 1950.

2/ All data on volume by type of container were taken from the annual reports of the Citrus and Vegetable Inspection Division, Florida Department of Agriculture.

3/ Capel, G. L. The Use of Packing Labor in Florida Citrus Packinghouses. Fla. Agr. Expt. Sta., Agr. Econ. Mimeo. Rpt. 57-58. (Agr. Mktg. Serv. cooperating.) June 1957.

Preliminary observations of the place-packing operation indicated that the work station could be improved to permit the packer to grasp the fruit more easily and to use a simpler and shorter motion pattern in packing it. With the conventional packing station, the packer faces toward the box with either the right or left side of the body toward the bin. The packer must turn from box to bin and back again, and she must reach far down into the corners of the bin to pick up the fruit (figs. 1 and 2).

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Figure 1.--Conventional work station for place-packing citrus fruit in wirebound crates.

A study of possible arrangements for increasing efficiency in place-packing showed that a sloping board (roll-board), with the box placed at the front edge and the board at a suitable height for the packer to stand facing toward the fruit, might be practicable. Gravity would cause the fruit to roll down the board to the packer. A chute device equipped with a foot-operated gate to control the flow of fruit into the box was also considered but was not tested.

Experimental work had been done on a roll-board type of packing station by Dr. Roy J. Smith and others working with him. 4/ After the information

4/ Smith, Roy J., and Haruo Najima. Rapid Pack of Oranges. Calif. Citrog. 42: 340, 345. August 1957.
Smith, Roy J., and Haruo Najima. Rapid Pack System for Oranges. Calif. Agr. 11(11): 3, 15. November 1957.

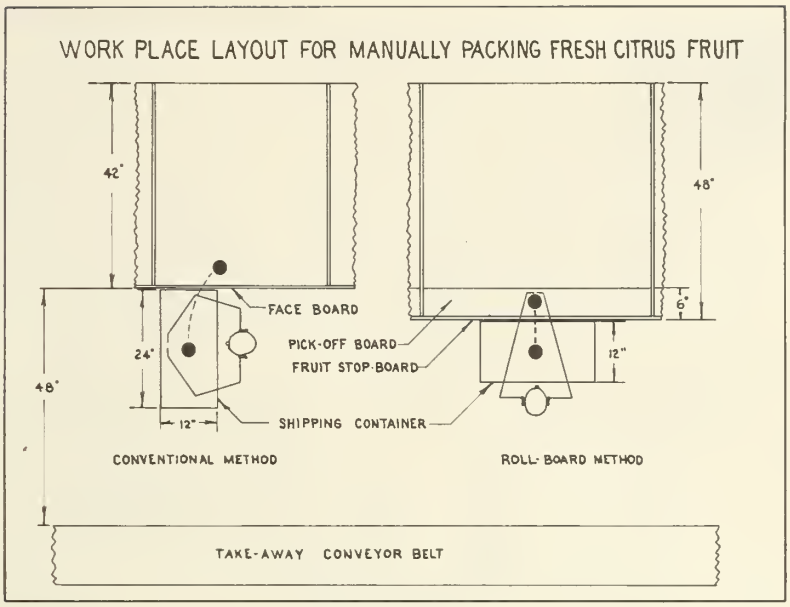

Figure 2

obtained from Dr. Smith was studied, a roll-board packing station was constructed for experimental work on methods of place-packing citrus fruit in Florida. An experimental model was constructed of wood for test purposes (fig. 3). It was designed as a one-person work station and had a bin capacity equivalent to two to three 1 3/5-bushel boxes.

A substantial number of packing tests were run with the experimental roll-board station to develop information on its use and to obtain preliminary time-study data to use in comparing this method with the conventional place-packing method.

CONVENTIONAL PLACE-PACKING EQUIPMENT

The equipment that has been used for manual place-packing for many years is commonly known as packing bins. For each row of bins there is a belt-and-roll sizer which discharges sized fruit into the bins. Divider boards are provided which form separate bins or compartments for each size of fruit coming from the sizer (fig. 1). Depth of the bins is usually 10 to 12 inches and the bottom slopes toward the bin front or work-face board. A packing stand mounted on casters is used to hold the box while it is being packed and to move the filled box to the take-away conveyor, which runs parallel to the bin row. Generally one take-away conveyor is placed in the aisle between two bin rows and serves both rows. The layout of the workplace is shown in figure 2.

ROLL-BOARD PLACE-PACKING EQUIPMENT

Equipment for the roll-board method of place-packing is essentially what the name implies: A sloping board on which the fruit rolls down in one layer to a stop-board which retains the fruit until it is picked up by the packer. Sized fruit is discharged from conveyor belts onto roll-boards when a central

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Figure 3.--The experimental model roll-board packing station.

sizer is used. Otherwise, the fruit is discharged directly from the sizer rolls to an attached roll-board provided with dividers for maintaining separation of the different sizes of fruit. Figure 2 shows the workplace layout for the roll-board method. The same take-away conveyor arrangement as that used for conventional bins may be used.

Construction and Installation

The roll-board with bins for accumulating fruit sketched in figure 4, which is based upon the experimental model, has not been tried in any Florida commercial packinghouse. Suggested construction for roll-board packing stations without bins for accumulating fruit is given in figures 5 and 6 and a bill of materials for an 8-foot section is given in table 1.

Computing Size of Roll-Board Needed

The total length of the roll-board, when not governed by the conventional belt-and-roll sizers, depends upon the desired output rate of packed fruit and the number of sizes to be accommodated. Thus when a central sizer is used, the roll-board length is divided into sections, or separate roll-boards are provided, for each size of fruit. Either movable or stationary dividers may be used to separate one size of fruit from another.

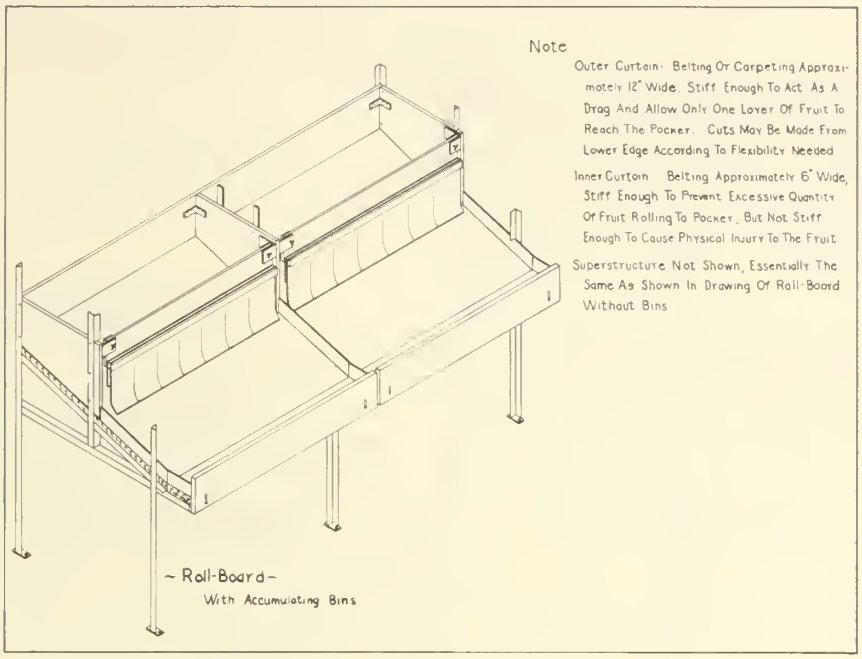


Figure 4.--The roll-board packing table with bins for accumulating sized fruit.

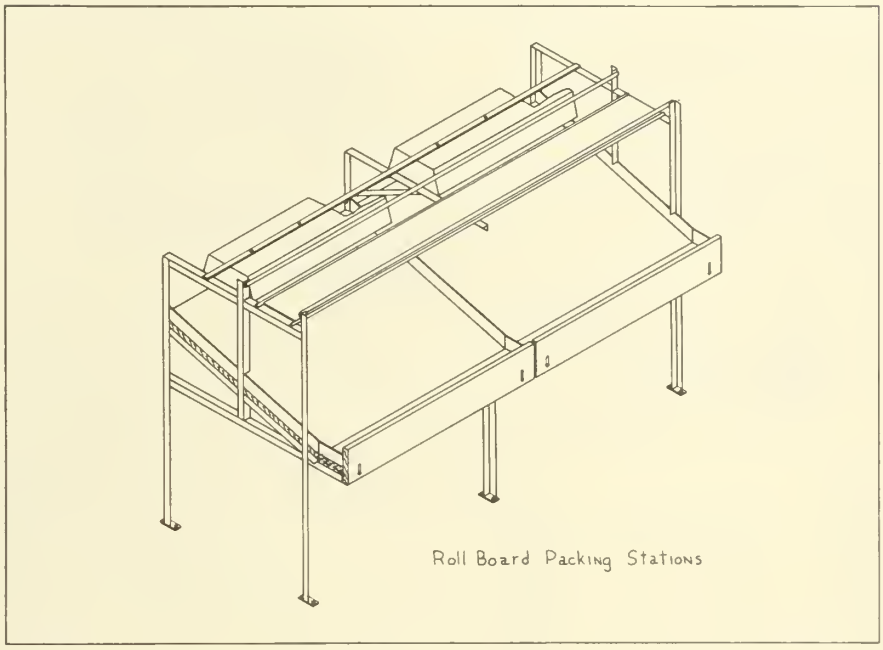
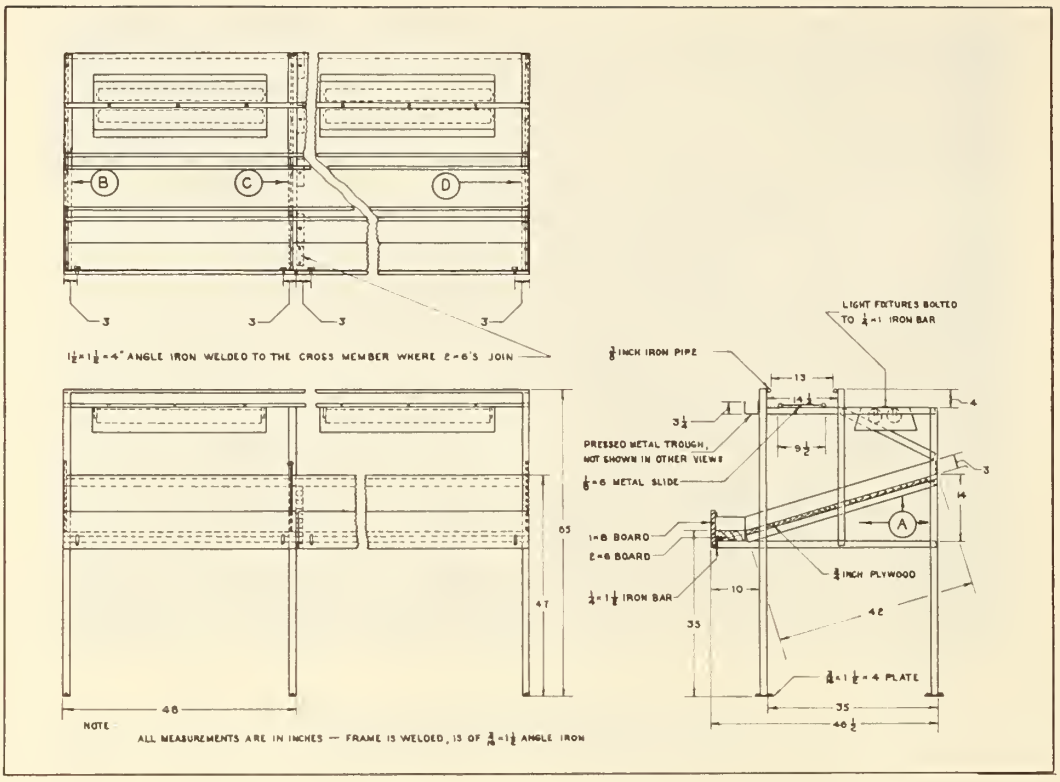


Figure 5.--General view of basic roll-board showing construction details including lights.



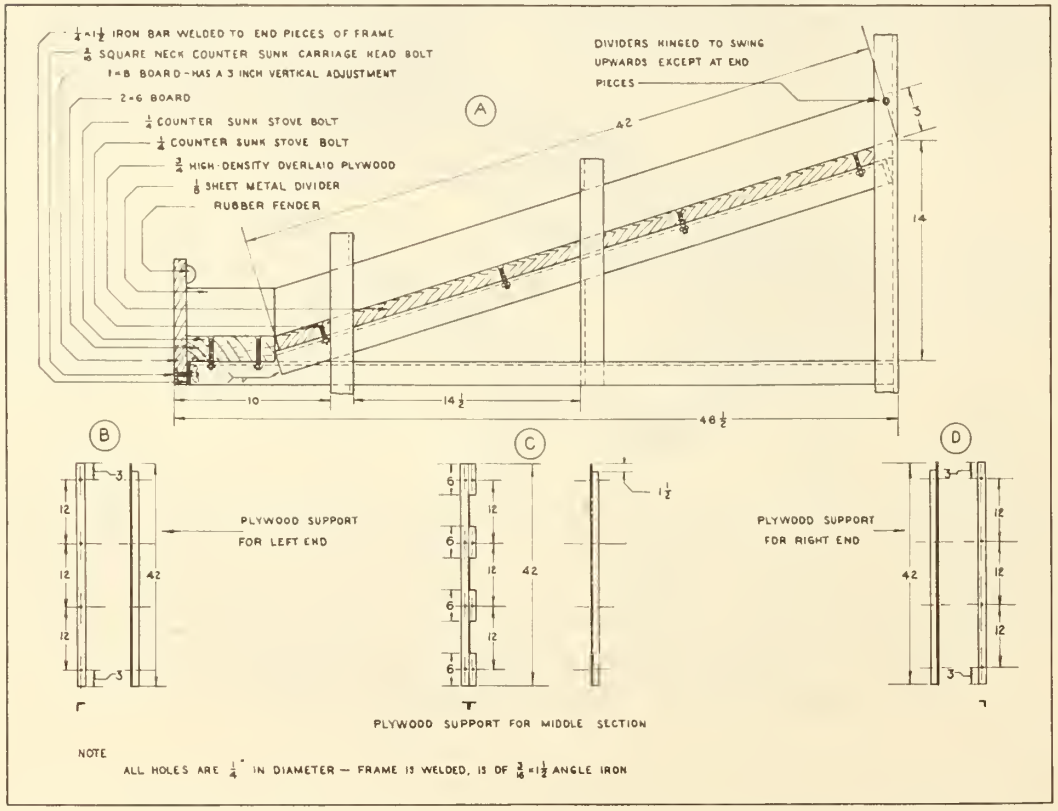


Figure 6.--Construction details for basic roll-board packing station.

Table 1.--Bill of materials for an 8-foot section of roll-board stations

Steel stock

Item number	Type of steel stock	Dimensions	Length	
		Inches	Feet	Inches
1	Angles	1-1/2 x 1-1/2 x 3/16	78	6
2	Hot-rolled strip	1-1/2 x 3/16	2	0
3	Hot-rolled flat	1-1/2 x 1/4	13	6
4	Hot-rolled flat	1 x 1/4	8	0
5	Hot-rolled strip	8 x 1/8	8	0
6	Hot-rolled strip	3 x 1/8	12	4
7	Black pipe, standard	3/8 diameter	32	0

Lumber

Item number	Kind of lumber	Size	Length
		Inches	Feet
1	Southern Pine "C"	1 x 8	8
2	Southern Pine "C"	2 x 6	8
3	Plywood, ext.-DEPA-A-C (or equivalent) 1/	3/4 x 42	8

Bolts

Item number	Description	Size	Quantity
		Inches	Number
1	Counter-sunk stove bolts and nuts	1/4 x 1-1/2	16
2	Counter-sunk stove bolts and nuts	1/4 x 3	8
3	Counter-sunk square neck carriage head bolts with wing nuts	5/16 x 3-1/2	4
4	Stove bolts and nuts	1/4 x 1	7
5	Floor fastener bolts	1/4 x 3	12

Table 1.--Bill of materials for an 8-foot section of roll-board stations -- Continued

Miscellaneous

Item number	Description	Dimensions	Length	Quantity
		Inches	Feet	Number
1	Pressed metal tray	3-1/4 x 3 x 1/8	8	1
2	Rubber fender (commercial weather stripping)		8	1
3	Industrial type fluorescent lighting fixtures, 2-tube			2

1/ High density overlaid plywood has higher initial cost but does not require initial application of finish; maintenance may be less for roll-board use, also, but supporting data are not available.

The approximate total length of roll-board that should be provided is computed by using the following formula:

For 1 3/5-bushel wirebound boxes:

$$L = \frac{3.5N}{25}$$

For 4/5-bushel fiberboard cartons or wirebound boxes:

$$L = \frac{3.5N}{36}$$

where N = total number of boxes of oranges to be place-packed per hour.
L = approximate total length of roll-board in feet.

This formula is also applicable when N is the expected output per hour for any given size of fruit. This formula was used to develop roll-board length required for each size of fruit given in table 2. A minimum of at least 3.5 feet should be allowed when the calculated roll-board length for any size of fruit is less than that. When calculated length is greater than 3.5 feet, allow an actual length that is the next highest multiple of 3.5. For example, if calculated length for a given fruit size is 12 feet, allow 14 feet (4 x 3.5 feet) of actual roll-board length.

Place-packing facilities will, in many cases be used part time for packing 1 3/5-bushel wirebound boxes and part time for packing 4/5-bushel fiberboard cartons or wirebound boxes. If the output in 4/5-bushel containers is the greater part of the total output, for example, the length of roll-board should be computed for that container. Oranges have been specified with respect to N in the formula since they normally require more packing time per box than grapefruit and therefore would require a greater amount of roll-board length for a given output rate.

Table 2.--Approximate roll-board length required by size of oranges for various rates of packing 1 3/5-bushel wirebound boxes

Orange size 1/	Roll-board length required when packing rate per hour is -			
	200 boxes	400 boxes	700 boxes	1,000 boxes
	Feet	Feet	Feet	Feet
125	4	4	7	7
163	7	14	22	32
200	14	25	42	59
252	11	18	31	45
Total	36	61	102	143

1/ Other sizes are not included because the volume, as indicated by experience, is negligible. Management can provide space for other sizes according to individual circumstances.

The total roll-board length may be provided by using more than one table, depending upon the arrangement most suitable for the floor space available for packing and other factors involved in a particular packinghouse.

Citrus fruit as it comes from the grove varies in size. Thus, after the fruit passes through the sizer in the packinghouse, the quantity delivered for packing will be different for each size. Table 2 shows the approximate division of roll-board length according to the average distribution of the fruit by specified sizes.

When considered solely for the purpose of placing fruit where the packer can easily grasp it, the width (dimension from stop-board to back edge) of the roll-board can be relatively small. However, to provide some capacity for accumulating fruit, which is desirable because of surges in the rate of flow to the packing equipment, a greater width of roll-board is needed. Table 3 shows the approximate quantity of oranges that can be accumulated in one layer on specified lengths and widths of roll-board.

Moving Fruit From Central Sizer To Roll-Board

The distribution conveyor system must be flexible to permit delivering fruit satisfactorily to different areas of the roll-board. When more than one roll-board is used, it should be possible to channel any size of fruit, except those of minor volume, to any roll-board and to more than one roll-board simultaneously. Without this flexibility, variation in the size of fruit may cause an overflow on one roll-board while on another roll-board unused area is available but not accessible to fruit temporarily exceeding the normal proportion of the total.

Table 3.--Quantity of oranges that can be held in one layer on roll-boards of specified lengths and of different widths 1/

Roll-board width 2/ (feet)	Number of 1 3/5-bushel equivalents of oranges in one layer on a roll-board with a length of - 3/						
	3.5 feet	5 feet	10 feet	20 feet	30 feet	40 feet	50 feet
	Number	Number	Number	Number	Number	Number	Number
1.....	0.29	0.42	0.83	1.67	2.50	3.33	4.17
2.....	.58	.83	1.67	3.33	5.00	6.67	8.33
3.....	.88	1.25	2.50	5.00	7.50	10.00	12.50
4.....	1.17	1.67	3.33	6.67	10.00	13.33	16.67
5.....	1.46	2.08	4.17	8.33	12.50	16.67	20.83
6.....	1.75	2.50	5.00	10.00	15.00	20.00	25.00

1/ To obtain quantity of grapefruit, multiply the values in this table by 1.5.
2/ Measured from the stop-board to the back edge of the roll-board.
3/ Based on 12 square feet per 1 3/5-bushel of fruit in one layer.

Installing Roll-Board Over Conventional Bins

A conventional setup of bins with belt-and-roll sizers may be converted to roll-board packing stations through a relatively simple and economical procedure, as shown in figures 7, 8, 9, and 10.

There are two important requirements however:

1. The top face of the pickoff board should be 34 to 36 inches from the floor to provide the correct working height for the packers.

2. The roll-board should have a slope of 15 degrees toward the packer so that fruit fed from the sizer will flow down the board as required by the packer.

Space for accumulating fruit will be considerably less than with the conventional bins, which are covered over in installing the roll-board.

Estimated overall cost for this type of roll-board installation is $5 per foot of length.

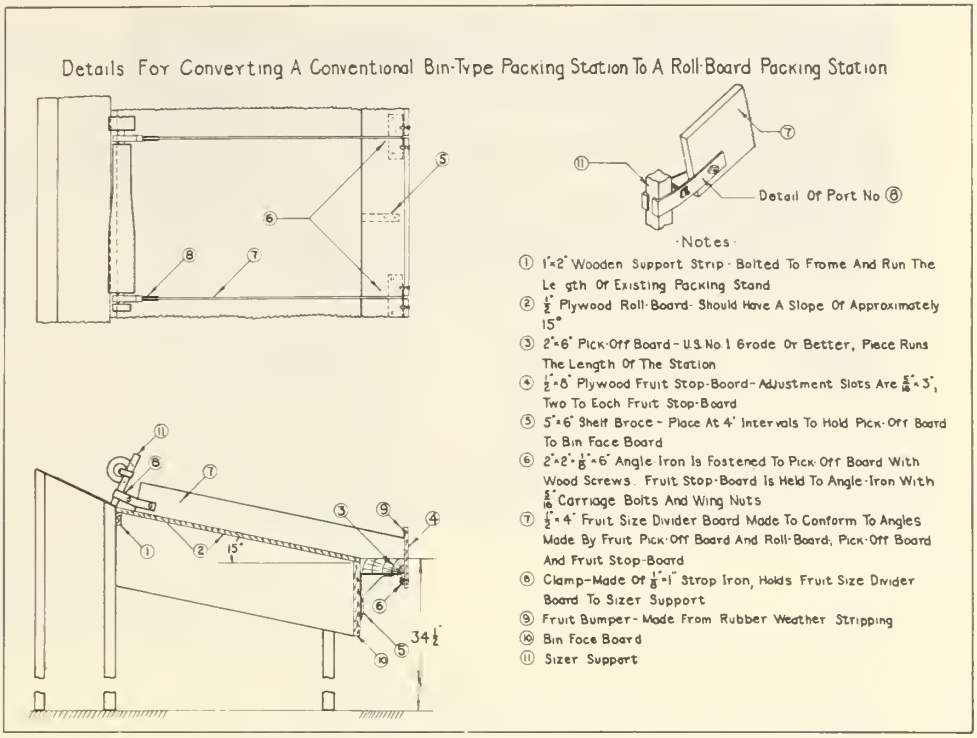


Figure 7

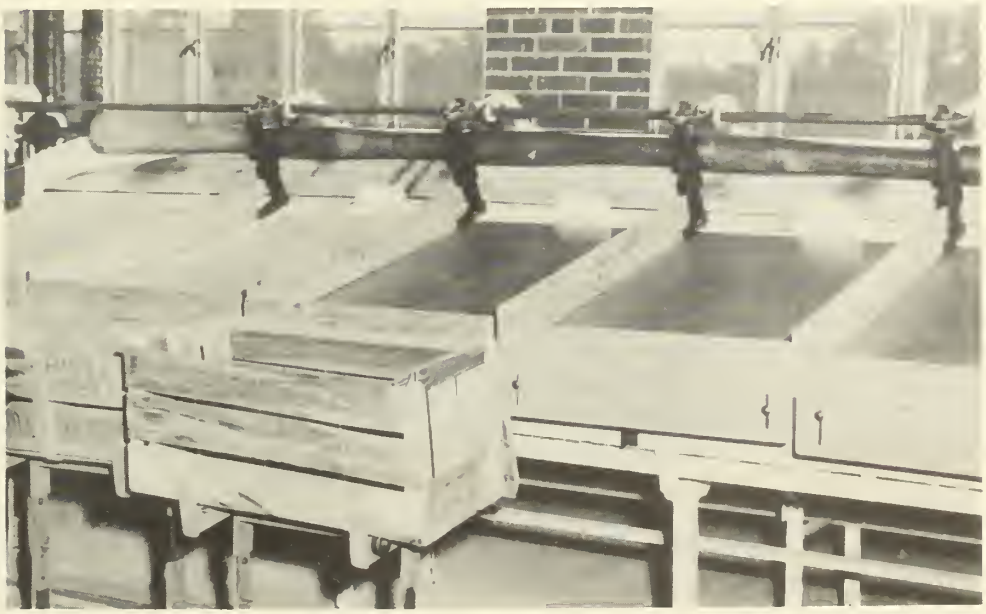


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Figure 8.--Roll-board packing stations shown here are installed over conventional packing bins at the University of Florida packinghouse. Stop-board adjustment slots and dividers are visible. High-density overlaid plywood was used for part of this installation and regular 1/2-inch plywood, smooth on one side, was used for the remainder.

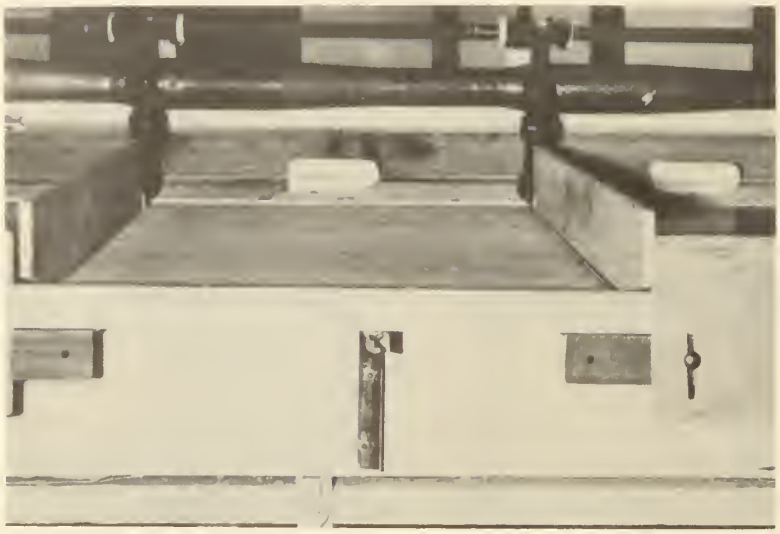

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Figure 9.--One section of roll-board with fruit stop-board removed to show the angle iron fastened to the pickoff board by wood screws. Angle iron has two 5/16-inch holes for bolts to hold the fruit stop-board. Shelf brace is also visible in the center.

Installing a Roll-Board in a Commercial Packinghouse

Roll-board packing equipment can be installed in place of the conventional bins used with the belt-and-roll sizers. In most plants, however, it will be necessary to raise the sizing equipment 9 to 12 inches from the floor to accommodate the roll-board packing station.

Another type of installation has been developed which utilizes the framework of the conventional bins to support the roll-board. This type of installation is simpler and less expensive, but does not readily lend itself to the incorporation of bins or return-flow conveyor to provide additional space for accumulating fruit. This installation is described in more detail in the section on installing roll-board over conventional bins.

Replacement of conventional belt-and-roll sizers with a central sizer provides more favorable conditions for the installation of roll-board equipment since changes in plant layout are required. With the central sizer the amount of roll-board area provided can be determined and based on needed packing space. With the old belt-and-roll sizers this was not possible because the packing space was built into the sizer itself. For a roll-board installation connected with a central sizer it is practicable to eliminate additional space for accumulating fruit, such as shown in figure 4, and feed the fruit directly to the roll-board from a return-flow belt or other suitable belt arrangement.

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Figure 10.--Roll-board being slipped into position over the conventional bins. The board is not fastened in place so it can be removed for the cleanup operation.

Labor Requirements

Tests conducted with the experimental model showed a potential saving of approximately 20 percent of the packer's time over that with the conventional packing method.

Comparative time-study data from commercial packinghouses are not available for all the different kinds of fruit and types and sizes of containers. However, data for some representative packs are given in table 4.

Since Florida citrus packinghouses pay packers on a piecework basis, the potential reduction in costs for manual packing operations may not be fully realized.

Labor savings can result through reduction in the size of the packing crew without any change in the piecework rates when plants pay certain packers, and perhaps all packers in some plants, an additional sum to bring their hourly pay up to a required minimum.

Increased productivity of the packers can make possible a higher rate of output for the entire packing line. This higher rate could reduce unit costs for other labor and equipment.

Two commercial packinghouses used the roll-board packing equipment for two seasons; both packinghouses indicated satisfactory results.

A comparison of labor cost for the conventional and roll-board methods of place-packing, assuming that piecework rates were actually changed to reflect a specified reduction in packing labor, is shown in table 5 for the shipping containers used for most of the fruit.

Table 4.--Comparative labor requirements for manual packing 1 3/5-bushels of fruit with the conventional bin and roll-board methods for specified fruit and container 1/

Job element	125 count oranges in 4/5-bushel fiber-board carton		27 count grapefruit in 4/5-bushel fiber-board carton		175 count tangerines in 4/5-bushel wire-bound box (flat)	
	Conventional bins	Roll-board	Conventional bins	Roll-board	Conventional bins	Roll-board
	Man-minutes	Man-minutes	Man-minutes	Man-minutes	Man-minutes	Man-minutes
Take container from chute..	0.12	0.12	0.12	0.12	0.20	0.20
Stamp container.....	.12	.12	.12	.12	.18	.18
Open container and position	2/ .22	2/ .22	2/ .22	2/ .22	.14	.14
Place-pack fruit.....	2.56	2.16	.96	.72	5.86	4.56
Take and insert cardboard strip.....	3/	3/	3/	3/	.16	.16
Put packed container on conveyor.....	.20	.22	.20	.22	.20	.22
Total 4/.....	3.22	2.84	1.62	1.40	6.74	5.46

1/ Allowance of 5 percent for personal needs of the worker and 5 percent for fatigue is included on all job elements for both methods of packing; an additional 5 percent is allowed on "place-pack fruit" for the conventional bin method.

2/ Telescoping 2-piece citrus carton formed and assembled before delivery to packer; top and bottom flaps sealed by machine after packing.

3/ Not used in fiberboard carton.

4/ Does not include time packer uses to record number of containers packed for piecework pay; procedure used varies for different packinghouses.

Table 5.--Comparative piecework rates for place-packing 1 3/5-bushels of citrus fruit by present and roll-board methods

Container type and size	Kind of fruit	Piecework rate with	
		Present method 1/	Roll-board method 2/
		Dollars	Dollars
1 3/5-bushel wirebound box	Oranges	0.0737	0.0590
4/5-bushel wirebound box	Oranges	.1022	.0818
4/5-bushel fiberboard carton	Oranges	.0860	.0638
1 3/5-bushel wirebound box	Grapefruit	.0570	.0456
4/5-bushel wirebound box	Grapefruit	.0747	.0598
4/5-bushel fiberboard carton	Grapefruit	.0778	.0622

1/ Rates are averages of those reported for 1958-59 season by packinghouses in a sample used for economic analysis by A. H. Spurlock, Agricultural Economics Department, University of Florida.
2/ Based on a projected labor reduction of 20 percent.

Equipment Requirements

The cost for constructing basic roll-board packing facilities is estimated at $24 to $30 per foot of length including material and labor. This estimate is based upon cost of materials shown in table 1 and labor for constructing the equipment at $3 per hour. The estimated cost does not include any sizing or conveying mechanism. There is a difference in materials cost of about $1 per foot of roll-board length between high-density overlaid and regular external grade plywood.

Equipment cost per 1 3/5-bushels of fruit may be considered to be the same for roll-board packing stations as for conventional packing bins under corresponding conditions.

Factors To Consider in Roll-Board Operation

If maximum benefits are to be realized, all of the packers in the plant must change to the new motion pattern.

The fruit stop-board is adjustable for height. During packing, it is important to have the stop-board set as low as possible to provide the packer maximum ease in picking up the fruit from the roll-board.

Proper care should be given roll-board installations to prevent the surface from becoming sticky and hindering the free movement of fruit to the packer.

Tangerines and grapefruit, which have an ellipsoidal shape, can be handled reasonably well on the roll-board, but they do not roll down as freely as spherical fruit.

OTHER EQUIPMENT AND DEVICES

The basic roll-board has been used in two Florida packinghouses for two seasons. Except for the overflow return used in one of these packinghouses, neither of the installations includes any of the following features.

Dividers for Separating Fruit Sizes

Dividers that permit quick adjustment of roll-board area according to variation in size distribution in the lot of fruit, have been considered for use where more than one size of fruit is handled on one roll-board. This arrangement for accommodating the different sizes of fruit allows flexibility in roll-board space for the respective sizes when their proportions vary and minimizes the amount of space required for packing. However, the amount of attention required to maintain satisfactory adjustment of the dividers is not known.

Return-Flow Feed

A return-flow belt for feeding the fruit to the roll-board appears to have use here. Figure 11 illustrates such an arrangement. This way of feeding a roll-board could reduce the amount of roll-board area needed or could increase fruit accumulating capacity with a roll-board. The arrangement should be particularly suitable for a roll-board using dividers that are quickly adjustable, for the shunts on the return-flow belt would be movable and would follow adjustments in the dividers.

Overflow Return

A means of returning fruit from the roll-board and recirculating it when an "overflow" condition develops at packing stations is being tried in one installation. Fruit is fed to the roll-board from an ordinary distribution belt. Openings were cut in the roll-board in each size area at points over which the fruit normally would roll onto the roll-board when the given size area was nearly filled with fruit (fig. 12). Thus, when any given section of the roll-board becomes filled, the incoming fruit drops through the opening onto a belt conveyor which runs the full length of the table and serves all overflow openings.

Connecting belt conveyors carry the overflow back and feed it into the packing line again just ahead of the central sizer. The additional distance that this fruit must be conveyed and the resizing are undesirable because of

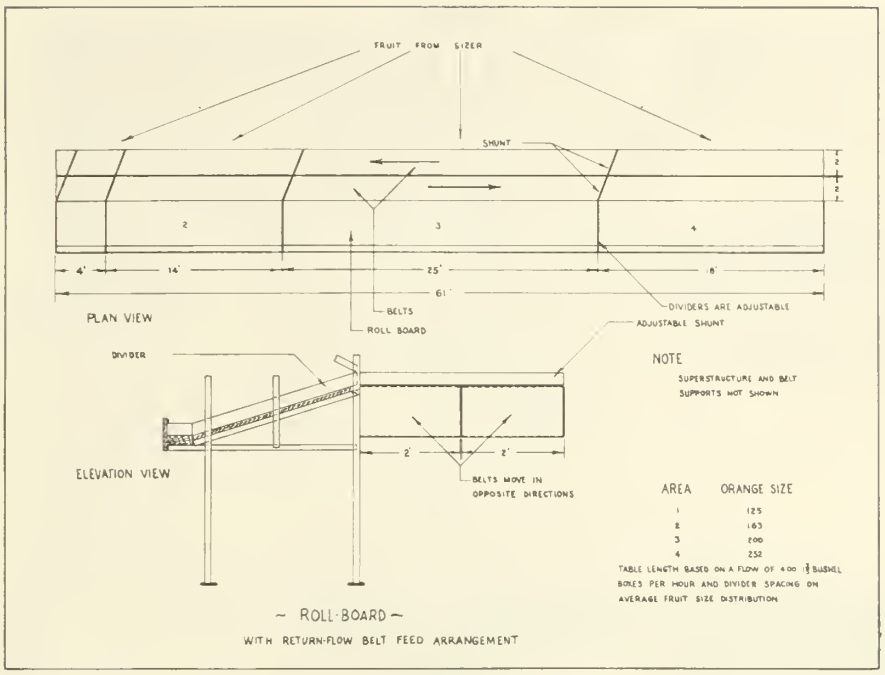

Figure 11.--Roll-board packing table with return-flow belt.

the mechanical injury which may result. Further development in the design of this overflow system is needed. Exact location of the overflow openings should be based upon observations of actual operation for a given roll-board installation, taking into consideration the direction of travel of the supply conveyor and the placement of diversion rods and shunts on the conveyor.

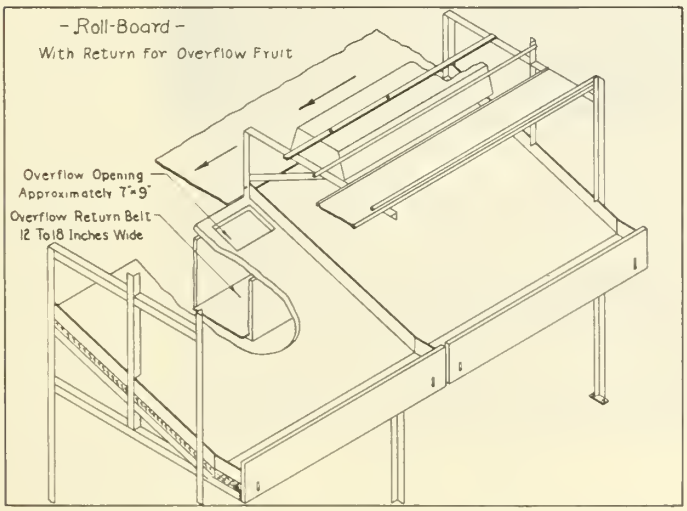

Figure 12.--Details of return for overflow fruit.

Packing Stand and Take-Away Conveyor

In one of the first commercial installations of the roll-board, a new type of stationary packing stand was devised for use with a belt conveyor, underneath the packing station, for removing packed boxes. This arrangement conserves space and eliminates the time-consuming movement required for the packer to place the filled box on the take-away conveyor, which is located between rows of packing bins in the conventional layout.

The construction and action of the stationary packing stand are shown in figures 13, 14, and 15. An "overcenter" effect holds the packing stand in the raised position and pulling the box toward the packer causes the stand to fold down to the level of the conveyor belt. The packer can then push the filled box off the rollers of the stand and onto the belt conveyor. The stand is returned to the raised position by grasping a crossbar and pulling upward and toward the roll-board.

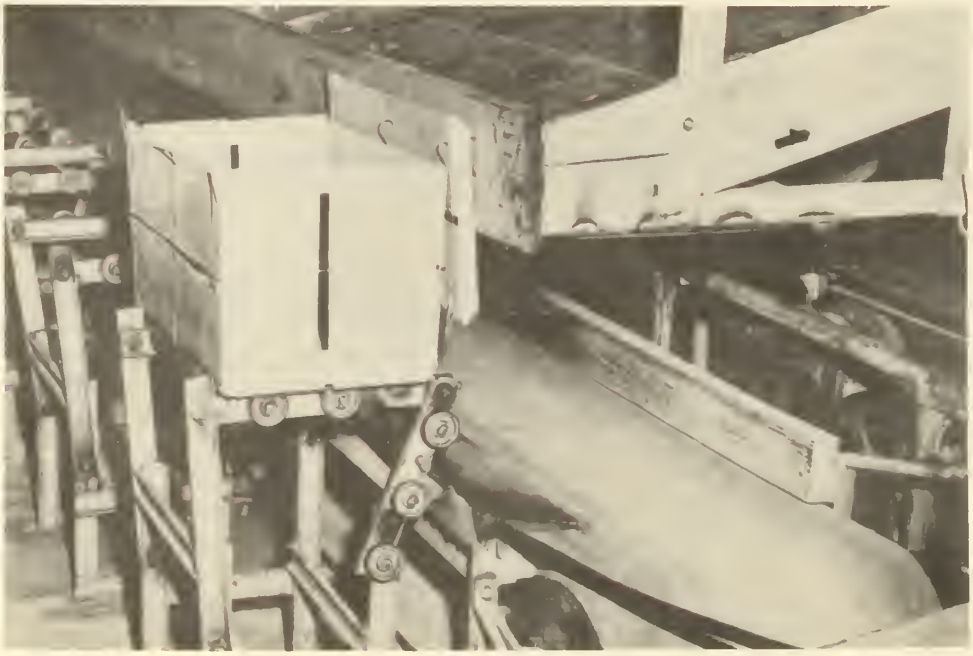

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Figure 13.--New type of stationary packing stand in raised position with box in position for packing.

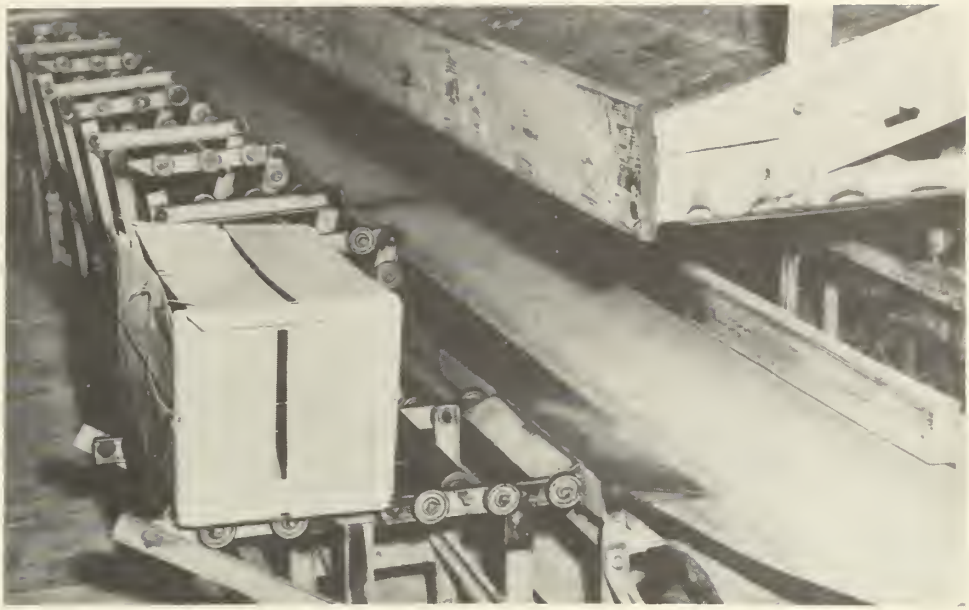

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Figure 14.--New type of stationary packing stand in lowered position. Box is pushed onto the take-away conveyor by the packer.

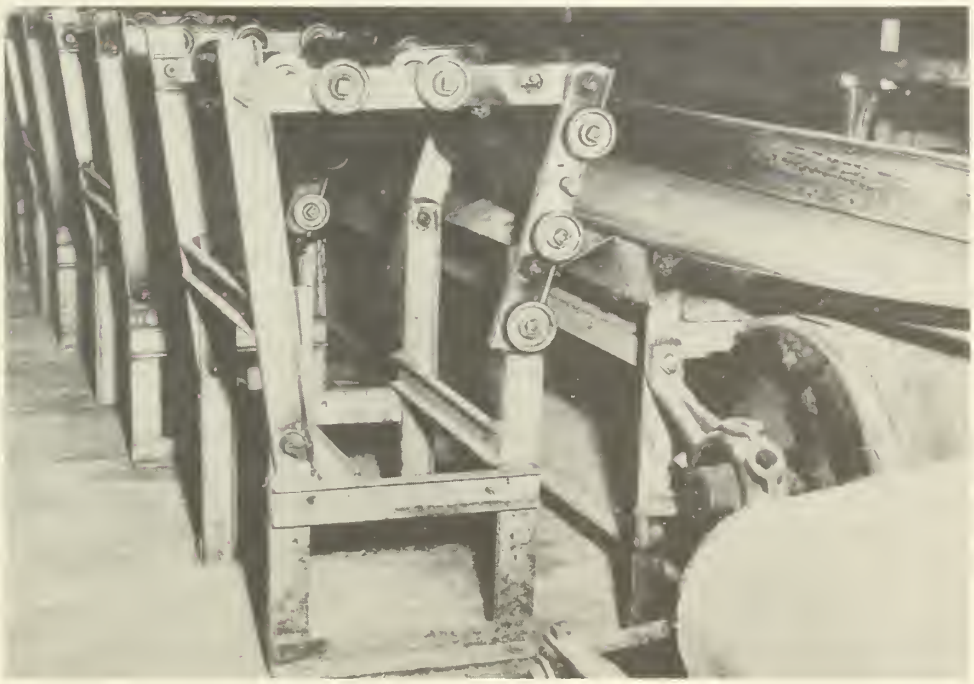

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Figure 15.--A closeup view of the new type of stationary packing stand in raised position.

CONCLUSIONS AND RECOMMENDATIONS

The roll-board method of place-packing eliminates most of the body motion involved in packing from the conventional bins. This reduces the effort required and makes increased packer productivity possible.

Data obtained on roll-board packing in commercial packinghouses indicate that a reduction of 15 to 20 percent in packing time may be realized with this method. Other advantages, and possible disadvantages, have been noted:

Advantages:

1. When fruit is presented to packer in one layer, the possibility of fingernail injury to the rind of the fruit is reduced.
2. Fruit "first in is first out" (especially important with precooled fruit)--whereas, first fruit into conventional bins may stay there taking punishment for hours.
3. Less effort is required to maintain a clean roll-board.
4. Installation is possible for all packing stations in a packinghouse or in combination with conventional bins or other packing equipment.
5. The roll-board type of packing station lends itself to the manual filling of consumer-size bags (bags suitable for retail sale to consumers). A number of Florida citrus fruit packinghouses pack in this size of bag part of the time.
6. Improved equipment for removing packed containers can be used since more space is available underneath roll-board packing stations than underneath conventional bins. The take-away conveyor for packed containers may be placed under each roll-board; in combination with the new type of packing stands, this setup eliminates the packer's rolling a packing stand to a take-away belt in the aisle.
7. In changing from old sizers to a central sizer, plants can easily connect roll-boards to accommodate the new flow pattern of sized fruit which normally employs only one delivery conveyor for each size of fruit.

Disadvantages:

1. Less space for accumulating fruit per running foot of packing facility.
2. Although incoming fruit of spherical shape flows down the sloping roll-board toward the packer with virtually no difficulty as fruit is removed from the roll-board, ellipsoidal fruit such as tangerines, Temple oranges, and some varieties of grapefruit may need a small push by the packer from time to time.